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TECHNICAL REPORT 3074

PRODUCTION ENGINEERING

OF

WARHEAD SECTION

762 MM ROCKET. PRACTICE: XM38 (M38)

SYDNEY GORDON

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JULY 1963

PICATINNY ARSENAL
DOVER, NEW JERSEY

TECHNICAL REPORT 3074
PRODUCTION ENGINEERING
OF
WARHEAD SECTION
762MM ROCKET, PRACTICE: XM38 (M38)

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JULY 1963

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SECTION I

INTRODUCTION

This report provides a comprehensive summary of the production engineering project for the XM38 Warhead of the Honest John Missile.

The report describes the major aspects of the production engineering work -- including briefly the R&D efforts that preceded the industrial engineering program.

Included are descriptions of the final production-engineered item and components, descriptions of the investigations performed, the improvement work performed on the product and on production processes, and the development of inspection and quality assurance techniques.

SECTION II

SUMMARY

The Warhead Section, 762mm Rocket, Practice: M38 is the result of production engineering the Warhead Section, 762mm Rocket, Practice: XM38.

The M38 Warhead is an Honest John Warhead which consists of an aerodynamic shell, structural members, fuzing system, two flash-smoke charges and a ballast assembly. It has the same weight, contour and centers of gravity as the M144 (T2044E1) Warhead Section. The M38 Warhead Flash-Smoke charges are located in the aft section of the warhead and have a minimal weight consistent with visibility requirements.

The M38 Warhead is designed to simulate the M144 Warhead Section, thus providing the using troops with experience in field handling and firing procedures of the M144 HE Warhead. The operational stages of the warhead section include delivery of the warhead to the target area, using either the Honest John M31 Series Rocket or XM50 Rocket as the vehicle, and detonation of the flash-smoke charges indicating point of warhead event.

The Honest John Rocket is a free-flight artillery rocket with a solid-propellant motor. The rocket was designed for tactical use by the field artillery. The M38 Warhead will be utilized primarily with the XM50 Rocket System which is the Improved Honest John Rocket. The rocket is launched from the self-propelled XM386 Launcher, which is variable in azimuth and elevation. With a 1,625-pound warhead section, the rocket has a maximum range of about 35,000 meters.

The Honest John Practice XM50 Rocket consists of an M38 Warhead Section with an M421 (T2075E1) Rocket Fuze, a pedestal section to house the XM37 JATO Spin Rocket System (and provide access to the motor igniter) an XM31E1 JATO Assembly and four stabilizing fins.

The M38 Warhead for the Honest John has been designed, production engineered, standardized, and is in production. This report provides a final summary of the industrial engineering effort in the development of the M38 Practice Warhead.

The fundamental objective for production engineering the XM38 Warhead was the translation of the R&D design into a "mass production" design.

The specific objectives were to:

- a. Minimize manufacturing costs by providing a design which could be manufactured by the most economical methods, using the least costly materials, and a minimum of skilled manpower.
- b. Insure minimum requirements for critical materials and maximum use of standard components and materials.
- c. Minimize production lead time.
- d. Provide all the technical data required to effect quantity production (including drawings, specifications, inspection equipment drawings and a Description of Manufacture).
- e. Reduce destructive testing and government acceptance inspection to the lowest practical level by quality assurance system design.
- f. Provide a design which can be produced in quantity, consistently equalling or exceeding the performance and reliability levels established for the development design.

SECTION III

CONCLUSION

The objectives of the production engineering program were achieved. Description of Manufacture entitled "Warhead Section, 762mm Rocket, Flash-Smoke: XM38E1 Metal Parts Assembly": File No. 36-7-1024 dated March 11 1962, was forwarded to the Ammunition Procurement and Supply Agency (APSA) Joliet, Illinois. Also forwarded to APSA in December 1962 was the Final Technical Data Package reflecting the Type Classification as "Standard A" of the M38 Warhead Section. The final Industrial Engineering report of the warhead fuze entitled "Final Engineering Report on Industrial Engineering Project - 9599.0300/0400 Fuze, Rocket, MT, T2075E1" contract DA-30-069-ORD-2564, dated December 1960 was published and distributed by Frankford Arsenal. The third year production contract for the M38 Warhead is in effect, and warheads are being delivered to the troops.

The XM38 Warhead was production engineered at Picatinny Arsenal. However, many of the modifications were accomplished concurrently with the production engineering program for the T2044 (M144) Warhead (which was accomplished under Contract No. DA-11-022-501-ORD-2662, by the Minneapolis-Honeywell Regulator Company).

Production of the M38 Warhead is in its third year. A 35% cost reduction (approximately \$940) per warhead has been realized as a result of production engineering.

The tabulation below is based on the actual production figures of the M38 for the three-year period. (The warhead container duplicates the container for the M144 Warhead and is not included in this cost breakdown since production engineering of this item was not accomplished with M38 Warhead funds.)

Production Costs of Warhead Section: M38

	<u>Quantity</u>	<u>Unit Cost</u>
FY61	302	\$2008.34
FY62	460	1796.06
FY63	673	1581.41
Combined	1,435	1760.00

The estimated average cost for a similar quantity of XM38 (R&D) Warheads is \$2,700.

The production engineering program for the M38 (XM38E1) Warhead Section cost \$75,000 which was spent relative to Project 3607-0501. In addition, advantage was taken of all the applicable production engineering changes made to M144 Warhead Section. The total saving per production-engineered warhead realized in the production period was estimated at \$940, and for 1,435 warheads an estimated \$1,350,000 savings was realized.

The reduction in cost was attributed to design work which eliminated components, enabled more economical fabrication methods and the use of less costly materials. Specific examples of cost saving and improvement areas include:

- a. A onepiece ogive skin was designed to permit fabrication by the Floturn process.
- b. Quick acting aircraft-type lockdown latches, which replaced a screw-actuated slide hold-down and nose ring arrangement, were utilized in locking the ogive assembly in place.
- c. The extruded aluminum shields were eliminated.
- d. A complex cast frame separation was replaced by a simple cast ring.
- e. The charge well was converted to a simple casting from a machined fabrication.

Maximum engineering effort has been directed toward production capability of the item at low cost. All parts and assemblies were carefully scrutinized for materials, dimensions, tolerances, geometry and finishes that enhance producibility of the item.

Functional and safety characteristics were maintained throughout the program. Changes in design were proven by intensive tests. The production-engineered items were overtested to assure that they were as good or better than the R&D items.

A quality control system was developed and purchase specifications formulated which will maintain high end item reliability. Functional gaging was developed to meet the required production capabilities. This equipment, together with the realistic acceptance quality levels developed, resulted in low inspection cost.

SECTION IV

RECOMMENDATION

Production engineering of training or practice warheads, having components common to tactical warheads, should make every effort to take advantage of production engineering performed on the tactical warhead. This would minimize engineering costs and maximize savings as accomplished with this program.

SECTION V

STUDY

I. DEVELOPMENT BACKGROUND

PROJECT INITIATION

In a letter report dated 10 June 1958 from United States Continental Army Command (CONARC), Fort Monroe, Virginia, to Chief, Research and Development, Department of the Army, Washington, D. C., Subject: "Report of Project FA 857 Service Test of Head, Flash-Smoke 762mm Rocket XM4E1 (Practice Warhead)" the following conclusions were made:

- a. The XM4E1 is incompatible with the XM50 Rocket.
- b. The XM4E1 is unsuitable for H37 Helicopter delivery.
- c. The XM4E1 is not fully suitable for field artillery use as a practice warhead, but much better than a concrete ballast warhead.

This letter also recommended that the XM4E1 Warhead be modified to incorporate the following changes:

- a. The fuze and fuzing arrangement be designed to conform to the M6 (HE)-type warhead.
- b. Substitution of two 10-lb TNT charge cannisters for the 72 pounds of photoflash powder, or substitution of other appropriate materials that will permit safe use in helicopter transport training while retaining sufficient flash and smoke capability.
- c. The weight shall correspond to the M6 (HE)-type warhead.
- d. The warhead should be compatible with the XM50 Rocket.
- e. The modified warhead shall be capable of parachute delivery and external helicopter transport by appropriate helicopters.
- f. The modified warhead must be unclassified and releasable to our allies who are armed with Honest John.

Shortly after this letter was written, development of the T2044 (M144) Warhead Section began. The T2044 (M144) Warhead is compatible with both the XM50 and M31A1C Rocket Systems and incorporated a different and improved fuzing system. Therefore, development of the improved practice warhead would simulate the new T2044 (M144) Warhead Section.

In a letter to Picatinny Arsenal dated 7 November 58 from Army Rocket Guided Missile Agency Subject: "Requirements for practice head for XM50 Rocket (U)", R&D funding for the new project was promised and the following requirements of the new practice warhead were given:

- a. The warhead shall have the external contour of the T2044 Warhead.
- b. The warhead shall utilize the same fuzing and fuzing access of the T2044 Warhead.
- c. The weight of the warhead shall be $1,625 \pm 12$ lbs.
- d. The center of gravity shall be at STA 80.4
- e. A small pyrotechnic charge, capable of being seen day or night from a distance of 15 miles, will be used. This charge will be located aft of STA 100 thereby having the least effect on missile airflow subsequent to initiation of charge.
- f. The charge shall be the proper size and arrangement so as not to rupture the warhead skin when initiated.
- g. The minimum functioning time of the warhead shall be four seconds.
- h. The warhead must be compatible with the XM50 and M31A1C Rocket.
- i. The security classification shall be UNCLASSIFIED.

With these requirements and the receipt of funds, work was initiated by the R&D Group at Picatinny Arsenal to develop the new practice warhead which was designated Warhead Assembly, 762mm Rocket, Flash-Smoke: XM38.

PROJECT DEVELOPMENT

Flash-Smoke Charge

At the time development was initiated on the XM38 Warhead, personnel in the Pyrotechnic Laboratory at Picatinny Arsenal were experimenting with various types of spotting charges. Spotting Composition 580 (60% barium nitrate, Class 2 140 ± 40 microns and 40% atomized aluminum, Type II, 22 ± 8 microns) was the most promising. At tests conducted at Fort Sill, Oklahoma, in which observers were stationed at 5, 10 and 15 miles from target, various weights of this component were tested. Based on light intensity, duration of the flash, and smoke, it was determined that 1 1/2 pounds of spotting composition was optimum. The charges have a minimal weight consistent with visibility requirements. This composition is capable of being seen from 15 miles during the day or night. Observers will see a flash, followed by a white-smoke cloud, at the point where the flash was observed. There are two spotting charges per warhead which increase the reliability.

Detonating Lead Assembly

The detonating lead assembly (Figure 1) serves as the intermediary explosive assembly between the M421 (T2075E1) Fuze and the two spotting charges. Its function is to continue the explosive train from the output tubes of the fuze, located at station 22.5 rearward, to the two spotting charges, located at station 107.5 (Figure 2). In designing the detonating cord a product had to be found with instantaneous speed of detonation, and with the capability to transmit enough energy to initiate the spotting charges, but not enough to cause structural damage to the warhead. After considerable research a low energy detonating cord, Pyrocore (DuPont tradename) was found which met the design requirements. The detonating lead assembly consists of an RDX booster tube assembly and four lengths of 30 grains/ft PETN detonating cord, with end primers having approximately 3.0 grains PETN crimped to each end of detonating cord.

Ballast Assembly

The ballast assembly (Figure 3) was designed to complete the weight and center of gravity requirement of the warhead. It is constructed of steel and consists of 29.7" diameter plate 1/2" thick, a 4 1/2" O.D. steel pipe with three steel supports placed 120° apart, and 14 one-inch-thick steel plates of 20" diameter. All parts of the ballast are joined by welding. The ballast assembly is secured to the base frame of the warhead by 15 bolts.

Fuze, Rocket, Mechanical Time

The XM38 Warhead utilizes the T2075 Fuze (Figure 4). This fuze and the fuze access is exactly the same as the T2044 (M144) Warhead Section, thus providing the using troops with experience in firing procedures of the tactical warhead. The warhead fuze is a mechanical clockwork device which, at the preset time interval, fires a detonator. Then the detonator initiates the detonating lead assembly. The fuze consists of two identical timer units bolted together to form the complete fuze. Both timer units are individually set and function independently of each other. Each of the fuze timer units has a timer, a safety and arming device and an explosive train consisting of an M19A2 Detonator and an RDX lead assembly.

Carrier

The carrier is basically fabricated from aluminum. Since the outside contour of the carrier is the same as the T2044 (M144) Warhead the using troops can gain experience in field handling and firing procedures of the HE Warhead.

The carrier (Figure 5) consists of an aerodynamic (structural) skin which is assembled from formed aluminum sections and one piece frames which support the skin at five positions. These frames are located at station 22.5, 47.5, 59.3, 100 and 115, a station specified in inches from the nose of the head.

ENGINEERING USER TESTS

In an artillery demonstration at Fort Sill, Oklahoma on 11 August 1959, Picatinny Arsenal was requested to have available an XM38 Warhead to fire using an M31 Rocket Motor. The warhead was fired and functioned properly.

Engineering tests were conducted during October and November of 1959. Four rounds were fired successfully.

Two XM38 Rounds were sent to CONARC at Fort Bliss, Texas for User Tests. The warheads were road tested on improved and unimproved roads, and were tested for physical characteristics, troop handling and troop safety. At the end of these tests the two warheads were fired successfully.

In a letter dated 10 December 1959 from the President, U.S. Artillery Board, Fort Sill, Oklahoma, to Commanding General, CONARC, Fort Monroe, Virginia, the successful tests below were noted and the following conclusions were made:

- a. The XM38 Practice Warhead is suitable for interim field artillery use with M31 and XM50 Series.
- b. The XM38 should be Type Classified for limited production.
- c. Production of XM38 Warhead be initiated and production of the XM4E1 Warhead be phased out as soon as possible.
- d. Final Classification of XM38 Warhead be withheld until completion of Phase II of Service Test (User Test).

II. PRODUCT & PROCESS DESIGN

This analysis of the components in the metal parts assembly of the Warhead Section, 762mm Rocket, Practice, M38 is presented by the major assemblies. The assembly process flow chart for the metal parts assembly is in Figure 6.

The XM38 Warhead was production-engineered at Picatinny Arsenal. However, many of the production-engineered modifications were done concurrently with the production engineering program for the T2044 (M144) Warhead, which was accomplished under Contract DA-11-022-501-ORD-2662 by the Minneapolis-Honeywell Regulator Company.

A. SHIPPING AND STORAGE CONTAINER (8824941)

The M38 Warhead Section is stored and shipped in a reusable container of a wood frame with exterior plywood construction and has a shock mount assembly bolted to its base (Figure 7). The top, sides and ends of the container are secured to the base and to each other with quick locks, to facilitate rapid and easy assembly and disassembly of the crate. The shock mount assembly has two mounting brackets which are removed and fastened to the warhead section before positioning the section in the crate.

The mounting brackets (Figure 8) are attached to the metal parts assembly at the mounting holes, located on the base frame at Station 100. The mounting bracket has lifting holes which accept lifting hooks, to facilitate positioning or removing the warhead section from the shock mount assembly. Suspension yokes are snugged under the separation frame at Station 59 to distribute the weight of the warhead section when resting in the crate. A band is placed around the warhead section and tightened to the suspension yokes. Then the crate is reassembled and, after proper inspection, is sealed. The M38 Warhead is ready for storage or shipment.

B. WARHEAD SECTION, 762MM ROCKET, PRACTICE: M38 (8838005)

The general assembly consists of the metal parts assembly with the spotting charges installed. In the XM38 Warhead the spotting charges were placed in a box which was mounted in the shipping container and the spotting charges were installed in the field. The M38 Warhead has the spotting charges installed in the warhead prior to shipment, thereby eliminating their box and packing carton.

Spotting Charge Loading Assembly (8833417)

Approximately 1 1/2 pounds of Spotting Composition 580 is placed in each spotting charge canister (Figure 9).

In the production engineered spotting charge assembly, Epiphen Adhesive 825A, replacing cycleweld, is used to fasten the bottom cover to the canister. Epiphen adhesive has greater impact, tensile and shear strength than cycleweld at any temperature from -65°F. to 160°F., and retains sufficient strength under stringent salt spray, weathering, and fluid immersion tests. This change provides a spotting charge assembly which will function reliably under extreme conditions.

Spotting Charge Metal Parts Assembly (8833418)

There are two spotting charge canisters per warhead. The M38 Warhead spotting charge was redesigned to provide fool-proof assembly into the charge well and easy removal using standard tools. Inclusion of a flange at the insensitive end of the spotting charge precluded the possibility of improper positioning and serves for extracting the charge, if it became necessary.

Another revision to the spotting charge assembly includes soldering of the disc and top cover.

The spotting charge metal parts assembly consists of copper components which are assembled by 360° soldering.

The manufacture of the spotting charge metal parts and the loading of the spotting charge is included in Description of Manufacture entitled "Charge Spotting for Warhead XM38E1 for 762MM Rocket" 34-5-72.

Fuzing System

Fuze, Mechanical Time: M421 (T2075E1) is used with the M38 Warhead Section. The fuze contains two independent clock mechanisms set to fire at

a predetermined time. The timing mechanism starts instantly upon acceleration of the rocket as it leaves the launcher. At the elapse of the pre-set time interval, the time fuze initiates stab detonators which fire into tetryl lead cup. From the lead cups the remaining explosive components are initiated, including the two spotting charges which produce both a flash and a white smoke cloud.

The XM38 Warhead Fuze Pack had desiccant bags inside the can. Reports from the field indicated that fuze packs were found with broken desiccant bags and these warheads did not function during flight tests. In view of the probability that desiccant bags will break under severe conditions, action was taken to repack all stockpiled fuzes in a dry atmosphere in lieu of desiccant. All current production fuzes are packed without desiccant.

The fuze pack is placed on the floor of the container for shipment. In the field the fuze pack is placed in the ogive for further transportation (Figure 10).

C. METAL PARTS ASSEMBLY (8833470)

The metal parts assembly is the Warhead Section, 762MM Rocket, Practice: M38, without the spotting charges. It consists of an aerodynamic shell, structural members, low energy explosive train and a ballast assembly. The metal parts assembly is fabricated in three general sections:

The ogive rocket furnishes access to the fuzing system and forms the aerodynamic entrance shape of the head.

The body assembly continues the windshield and aerodynamic shape of the head. This assembly contains the fuzing and arming system which initiates the detonating head assembly. The detonating lead assembly serves as the intermediary explosive assembly between the M421 Fuze and the two spotting charges. The assembly was designed to transmit enough energy to initiate the spotting charges but not enough to cause structural damage to the warhead. The base and ballast assembly gives weight to the warhead section. The ballast is designed so the weight and center of gravity of the warhead simulates that of the M144 Warhead Section. The aft end of the base and ballast assembly mates with the rocket motor. A diaphragm assembly covers the aft end to prevent the entry of dust and dirt.

The body assembly is attached to the base and ballast assembly by screws. The ogive rocket is attached to the body assembly by inserting the telescoping rod in the appropriate hole in the fuze ring and locking it in place by two screws in an index. Then the fuze holder adapter assembly is fastened to the

fuze ring assembly.

The assembly is primed and painted per finish No. 215, color X24087 (Olive Drab) of MIL-STD-171. Four white squares and white markings indicate the type of head and locate the center of gravity. Then the nose is opened and silicone grease is applied to the gasket at station 22.5 to prevent freezing during storage.

Washer (MS20002-C8)

Four MIL-Standard washers are used when the head is mounted to the motor. The washers are contained in an accessory package taped to the base section of the warhead.

Bolt (NAS 148 DH-32)

Four bolts with four military standard washers fasten the warhead to the rocket motor. The bolts are a commercial item and are contained in an accessory package taped to the base section of the warhead.

Plugs (8798093)

Four plugs fit into the lifting holes of the base frame after the lifting brackets have been removed. These plugs restore the aerodynamic contour of the head. They also keep the rocket from "whistling" while in flight. The plugs are automatic screw machine parts and are machined from 2011-T3 aluminum alloy bar Specification QQ-A-365. The plugs are contained in an accessory package taped to the base section of the warhead.

Screw (AN509-416R12)

The body assembly is fastened to the base and ballast assembly by 90 screws.

Screw (MS 35225-42)

Two MIL Standard screws are used to fasten the index to the fuze ring.

Index, Rod (8831170)

The rod, index orients the telescoping rod and prevents the nose assembly from being disengaged from the warhead while the time fuze is installed. The rod index is blanked and pierced from steel strip.

A tab on the index fits into a groove of the telescoping rod. The tab orients the rod and prevents the nose from slipping beyond the groove. The rod index is fastened to the fuze ring by two screws.

Ring Assembly (8833454)

The ring assembly is attached to the charge well using 12 AN509-416R12 screws. The ring is to contain the spotting charge in its housing during detonation. The disk, which is soldered to the ring, blows outward during detonation.

Ring (8833453)

The ring is machined from 4.5" OD x 1" FS1020 Specification QQ-S-635 steel tubing.

Disk (8833474)

The disk is blanked from copper strip, Specification QQ-C-576.

Plate, Confining (8833452)

The two plates, when joined, confine the end primer into the charge well. The confining plates are fabricated from strip or bar steel, FS4130 Specification QQ-S-624.

D. OGIVE, ROCKET (8833448)

The ogive rocket at the forward end of the warhead provides a wind shield for the warhead and a housing for the rocket fuze. The development of this section from the non-production engineered design was guided by the following objectives:

An ogive rocket to permit mass production

An assembly of the simplest functional design possible

An assembly allowing quick access to the mechanical time fuze without using tools.

The non-production engineered ogive rocket had two clevis rods, extending down through the fuze ring assembly, from a ring mounted to the nose skin. These clevis rods were locked to the fuze ring assembly by a "roller skate clamp". This design allows the skin ogive to be swung completely out of

the way while setting the fuzes. The "roller skate" clamping mechanism was operated by inserting a screw driver through a hole in the forward skin and turning the threaded clamp bar. Since this operation was not quick acting and required the use of a screw driver, this design was not in accord with the design objectives. A further disadvantage of this design was that an improperly clamped nose assembly may not be detected.

The final production-engineered M38 ogive, rocket consists of a one-piece ogive skin (Station 0 to 22.5) two well designed latches eliminating the need of a screw driver to operate and a telescoping rod assembly which provides an interlock of the ogive rocket to the body assembly.

Skin, Ogive (8833465)

In the non-production engineered model this skin was a hollow truncated cone which formed the skin surface from Station 3.5 to 22.5. Fabrication was accomplished in the following manner. A shaped blank 0.081" 6061 aluminum alloy sheet was preformed to a conical shape, welded together, spun to the exact conical shape, heat treated to a T6 condition, and trimmed to the desired length. This fabrication technique was quite costly, due to the welding operation and the resulting high scrap rates.

In the production engineered warhead the skin ogive is flow turned. The flow turning process yields a superior product with no weld seams and requires fewer manufacturing operations. The tip and the skin became one part.

Latch Assembly (8831276)

The latch assembly uses an over-center toggle action for primary locking, and incorporates a push button release and a secondary safety lock. To release the lock (Figure 11) the push button is depressed which releases the secondary safety lock. Depressing the push button further causes the button to press on the end of the locking lever, which pushes the lever system over center and releases the latch. When the latch is in the unlocked position, spring action holds the latch lever out, making an unlocked latch in a nose assembly conspicuous due to the protruding lever.

Latch Base Assembly (8831289)

The latch base assembly provides the structural framework for the latch. The assembly is of welded construction and consists of one plate, one backup plate, one left bracket, and one right bracket.

Plate (8831290)

The plate forms the main structural frame of the latch. It is blanked,

pierced, and formed from 0.062-inch-thick steel, specification QQ-S-698.

Plate, Backup (8831291)

This plate adds structural rigidity to the latch and forms the containing well for the seal gasket. Steel 0.062-inch thick, Specification QQ-S-698 is blanked, pierced, and formed to make this part.

Left Bracket (8831292) Right Bracket (8831293)

The left bracket, with the right bracket, provide the pivot point for the latch lever and also acts as a guide for the hook assembly. These parts are made by blanking and forming 0.062-inch-thick steel, Specification QQ-S-698.

Hook Assembly (8833386)

The hook assembly includes the hook, two arms two rivets and one pin. The hook and arms are riveted together and the pin is pressed into the riveted assembly. The hook assembly is plated per Military Standard - 171 finish number 1.1.2.3 or 1.9.2.3.

Hook (8833387)

The hook mates with the pin of the clevis assembly. The hook is blanked and pierced from 0.125-inch-thick alloy steel 4130 per Specification QQ-S-627. Heat treatable alloy steel was used to meet the design requirements.

Arm (8833388)

The arm provides mechanical linkage between the hook and the latch lever. The arms are blanked and pierced from 0.125-inch-thick plain carbon steel 1007, Temper 2, QQ-S-698.

Lever Assembly (8831284)

The lever assembly provides the catch for the secondary locking system. The locking lever, the pushbutton, and the seal ring make up this assembly.

Pushbutton (8831287)

The pushbutton, when depressed, opens the latch. It protrudes thru the ogive skin and is contoured to match the external surface of the warhead. It is precision cast from aluminum alloy, Specification QQ-A-601, Aluminum Alloy 356, Temper T6.

Lever, Locking (8831288)

The locking lever provides the catch for the secondary locking system. Plain carbon steel 0.062-inch-thick is blanked, pierced, and formed to shape the piece. After forming, the piece is drilled and machined to complete fabrication.

Ring, Seal (8831286)

This ring forms a moisture proof seal between the nose skin and the pushbutton and is assembled to the formed groove in the pushbutton. Silicone rubber (AMS 3332) is compression molded to form the part. Several rubber materials were considered before silicone rubber was accepted for use on the warhead. Silicone rubber was selected due to its stable physical properties over a wide temperature range.

Lever, Latch (8831280)

The latch lever is the main actuating lever for the latch mechanism. It also forms the hook member for the secondary latch system. The lever is blanked and pierced from 0.125-inch-thick carbon steel per Specification QQ-S-698.

Spring, Latch (8831279)

The latch springs provide the spring action which aid in clearing the hook from the clevis and also holds the lever in an extended position while the latch is unlocked. The extension springs are formed from 0.031-inch-diameter steel wire per Specification QQ-W-470.

Torsion Spring (8831283)

The torsion spring keeps a constant pressure on the latch hook assembly which eliminates play in the assembly and aids the hook in engaging the clevis assembly. This spring is made from 0.037-inch-diameter steel wire per Specification QQ-W-470. The design of this spring has changed several times during the evolution of the latch to keep pace with changes in the latch configuration. Through all alterations, the function of the spring has stayed the same.

Pin Lever (8831277)

The lever pin forms the movable pivot joint for the latch lever system. It also provides an anchor point for the two latch springs. Alloy steel rod

per MIL-S-6758, Condition D, Surface Condition 4, is machined to make this part. On early designs of the latch, this pin served as an attachment post for the torsion spring in addition to the functions listed. This function required an extra groove to be machined in the pin to accept the spring. Redesign of the latch allowed the spring to be changed and the extra groove removed from the pin. A further improvement was made when the pin material was changed from case-hardened carbon steel to tough chrome-molybdenum steel. This change eliminated a heat treatment operation.

Spring (8831285)

This spring keeps the pushbutton tight against the skin surface. The material is steel music wire, 0.041-inch diameter per Specification QQ-W-470.

Seal Gasket (8831278)

The seal gasket forms a moisture seal between the latch lever and the nose skin. The part is molded from silicone rubber (AMS 3332).

The gasket was originally a flat, elongated rubber piece shaped to fit the gasket well in the latch base, and cut to clear the latch lever. Along this cut was a bead of material which squeezed outward to grip the latch lever when the latch was assembled to the skin.

The first rubber used was per Specification MIL-R-003065. This rubber tended to grip the lever too tightly, and after repeated opening and closing of the latch, the gasket worked into the slot and bound the lever. To reduce the binding of the lever, the gasket material was changed to a silicone rubber. This rubber had the desired slipperiness, and resisted the binding action satisfactorily.

To improve the moisture sealing characteristics of the gasket, the shape was redesigned to include two enlarged beads, which probed down along the latch lever near the pivot. These beads filled in the troublesome area effectively, and this gasket design became the final production - engineered version.

Shoulder Rivet (8833389)

Four rivets are used in the latch. One rivet forms the pivot for the latch lever, two others form the pivots for the locking lever assembly, and one ties the two latch base brackets and forms the hook retainer stop. These rivets are machined from annealed plain carbon steel rod per

Specification QQ-S-633 or QQ-W-461.

Rod Assembly (8833390)

The rod assembly provides the interlock system between the nose assembly and the forward assembly, and prevents the complete removal of the nose assembly from the warhead.

Fitting, Nose Rod (8833392)

The nose rod fitting provides a means of attaching the telescoping rod to the nose assembly. It is machined from an aluminum alloy and casting (Specification QQ-A-601 Alloy 356 Temper T6).

Rod, Telescoping (8833391)

The telescoping rod is the mechanical link of the interlock system between the forward and nose assemblies. The part is machined from alloy rod temper T4 per Specification QQ-A-268.

E. ADAPTER ASSEMBLY FUZE HOLDER (8831260)

This assembly enables a hermetically canned fuze to be attached directly to the fuze ring assembly (Figure 12). The can is placed in position when the warhead and fuze can are removed from the crate in the field. This arrangement eliminates the possibility of the warhead reaching the launching area without the fuze. A fuze holder adapter, a fuze clamp strap assembly, two flat washer MS 15795-209, two lock washers MS 35337-25, and two MS 35226-61 screws comprise the assembly.

Fuze Holder Adapter (8831261)

The fuze holder adapter attaches directly to the fuze ring assembly and provides the adapter between the canned fuze and the fuze ring. The part can be made from either an aluminum alloy bar or a precision aluminum alloy bar or a precision aluminum alloy casting.

Fuze Clamp Strap Assembly (8831262)

This assembly provides the clamping mechanism to hold the canned fuze to the fuze holder adapter (Figure 13). The assembly consists of the fuze clamp assembly, the fuze clamp spring, the fuze clamp lever, and one pin. Corrosion resistant materials are used throughout the assembly.

Spring, Fuze Clamp (8831263)

The fuze clamp spring supplies the spring action to the fuze clamp strap assembly. This spring action keeps the fuze clamp assembly tight when it is in the clamped position. Stainless steel wire (Specification QQ-W-423, Comp. FS 302, Condition B) 0.071-inch diameter is cut and formed into this part.

Lever, Fuze Clamp (8831264)

The fuze clamp lever provides the locking toggle action to the clamp mechanism. It is blanked, pierced, and formed from 0.040-inch-thick stainless steel (Specification QQ-S-766, Class 301, Condition A).

Fuze Clamp Assembly (8831265)

The fuze clamp assembly wraps around the fuze can, and with the aid of the clamp spring and clamp lever, locks the canned fuze in place. Two fuze brackets are spotwelded to the fuze clamp strap to form this assembly.

Strap, Fuze Clamp (8831267)

The fuze clamp strap wraps around the canned fuze and with the clamp lever and clamp spring forms the fuze clamp mechanism. This strap is made by shearing, notching, and forming 0.032-inch-thick stainless steel, Specification QQ-S-766, Class 301, Condition A.

Bracket, Fuze Clamp (8831266)

The fuze clamp bracket is the attachment link between the fuze clamp mechanism and the fuze holder adapter. The part is blanked, pierced, and formed from 0.062-inch-thick stainless steel, Specification QQ-S-766, Class 301, Condition A.

F. FUZE RING ASSEMBLY (8833475)

This assembly performs three important functions in the warhead assembly.

- a. It is the mounting platform for the fuze.
- b. It provides mechanical attachment for the ogive rocket to the body assembly.
- c. It is the initiating point of the pyrocore booster assembly.

The fuze ring assembly consists of the main support body or fuze ring, a fuze clamping system, two clevis arrangements for ogive, rocket attachment, and a pyrocore booster assembly.

To prevent the possibility of the warhead reaching the firing area without its rocket fuze, a canned fuze locking system was devised which allowed the hermetically sealed fuze to be clamped directly to the fuze base. This canned fuze would be installed on the warhead after the warhead is removed from the shipping and storage container in the field and would always accompany the warhead.

Ring, Fuze (8833462)

The fuze ring is the main support body for the fuze ring assembly. It provides a mounting platform for the fuze, and attachment link for the rocket ogive and body assemblies, and a housing for the lead holder assembly. The ring is machined from an aluminum alloy sand casting.

Gasket (8831243)

The gasket forms a moisture proof seal at the junction of the nose and forward skins. It is molded from rubber per Specification MIL-R-3065B and is assembled to the double groove in the periphery of the fuze ring. The gasket design was developed from the original single leg gasket to a double legged, channel gasket. These design changes eliminated a peeling down action of the gasket when the ogive rocket was attached. To further alleviate this peeling, a silicone grease (Dow-Corning DC-4) was applied to the gasket when the rocket ogive was permanently attached.

This procedure worked satisfactorily and the double-legged, channel gasket was accepted as the final production-engineered part.

Pipe, Sleeve (8831250)

The sleeve pipe is a guide in which the telescoping rod of the rocket ogive is inserted. It is machined from 6061 aluminum alloy pipe.

Clevis Assembly (8831258)

The clevis assembly provides the mating attachment mechanism for the rocket ogive latch system. This clevis assembly consists of three parts -- the clevis, the pin, and the clevis clip.

Lead Holder Assembly (8833434)

This assembly performs the function of transmitting the explosive force of the fuze flash tubes to the pyrocore booster assembly on the other side of the assembly.

The lead holder assembly consists of a holder and index assembly, a booster lead cup assembly and a disc.

Booster Lead Cup Assembly (8833428)

This assembly consists of the booster lead cup which is loaded with about 2.39 grains Teteryl, Grade I.

There are two booster lead cup assemblies per warhead and they are housed in the holder and index assembly. The explosive is covered by a disc.

Cup, Booster Lead (8833424)

The booster lead cup is manufactured from gilding metal, B2, Specification JAN-G-439.

Disc (8833423)

The disc which covers the explosive in the booster lead cup is either aluminum foil, or pressure-sensitive tape.

Holder and Index Assembly (8833433)

The holder and index assembly receives the booster lead cup and also forms the locating bar for orienting the fuze over the lead holder assembly. It consists of a holder and an index.

Index (8831256)

The index is blanked and pierced from cold rolled steel sheet 0.125-inch thick per Specification QQ-5-698.

Holder (8833447)

The holder is machined from steel bar B1113 Specification QQ-S-633.

Locator, Booster (8833427)

The locator booster holds the pyrocore booster assembly in contact with the lead holder assembly.

Bar (8831247)

The bar forms the movable clamping point in the fuze base clamp system. The bar is machined from 3/8-inch-diameter stainless steel Class 303, Condition A per Specification QQ-S-763.

Cam (8831244)

The cam actuates the bar for clamping the fuze base. The cam is a precision casting made from aluminum alloy, Alloy 356, Temper T6 per Specification QQ-A-601.

Cam Spring (8831246)

The cam spring provides the spring pressure, which holds the fuze clamp mechanism tight and locks the cam in the clamped position. Carbon steel 0.072-inch thick per Specification MIL-S-7947 is blanked, pierced, heat treated and cadmium plated to make this part. The first parts were not plated, but heavy corrosion made plating necessary.

The cam slides on the surface of the spring under heavy pressure. To make the clamp work easier, molybdenum disulfide was applied to the spring surface. This coating gave a smooth action to the clamp.

Clevis (8831259)

The clevis is the main structural link between the fuze ring and the nose assembly latch. It is machined from 3/4-inch hex stainless steel bar, (Condition A, Class 416) per Specification QQ-S-763.

Originally, the clevis was made from 9/16-inch hex stainless steel rod. The stock size was increased later to 3/4-inch hex to allow the addition of a 45° chamfer to the clevis slot. This chamfer helped to lead the latch hook into the proper position.

Clip, Clevis (8835932)

The clevis clip is a safety device to assure proper engagement of the latch and clevis assembly. The clip covers the end of the clevis. The clip prevents an improperly latched nose assembly from fully seating on the forward skin because the hook cannot bypass the clevis pin. A gap is left between the rocket ogive and the forward skin when the ogive rocket does not lock down, thus affording a visual check against improper locking. Beryllium copper per Federal Specification QQ-C-533 is blanked, formed, and drilled to make this part.

Cover, Pyrocore (8833427)

The cover forms a protective cover for the pyrocore booster assembly and holds the assembly in place. The cover is blanked and pierced from aluminum alloy, sheet 2024-T3 Spec QQ-A-355.

Pyrocore Booster Assembly (8833456)

The pyrocore booster assembly is a commercial item purchased from the E.I. Dupont De Nemours and Co. It consists of an RDX booster tube assembly and four lengths of 30 grain/ft PETN detonating cord, with end primers having approximately 3.0 grains PETN crimped to each detonating cord.

G. BODY ASSEMBLY (8833466)

The body assembly continues the windshield and aerodynamic shape of the head. This section extends from Station 22.5 to 100.0 and consists essentially of an external skin, the fuze ring assembly, the forward ring, the frame separation, and the detonating cord which runs longitudinally through the assembly.

The non-production engineered warhead had extruded aluminum shields longitudinally through the entire section. The pyrocore booster assembly was clamped to the back side of these aluminum shields and therefore was kept away from the inside skin wall of the warhead section. A complex cast frame separation was necessary to adapt to the junction of the forward and rear skin shields.

In the production engineered warhead it was determined that the low energy detonating cord that is used does not transmit sufficient energy to damage the skin even if clamped near the skin surface. With this knowledge gained from testing, the extruded aluminum shields were eliminated. The complex cast frame separation was also changed to a simple cast ring (Figure 14).

Skin, Forward (8833463)

The forward skin forms the structural link between the ogive skin and the rear skin and in conjunction with the ogive skin forms the windshield for the warhead.

Ring, Forward (8831233)

The forward ring is a strengthening member for the forward skin at the dynamic pressure center. It is blanked, formed on a punch press and heat-treated to the desired temper.

Skin, Rear (8833455)

The rear skin is the main structural member between the base assembly and the separation frame. The rear skin consists of an ogive contour which becomes a cylindrical section about Station 85.

Frame, Separation (8833476)

The frame separation furnishes the junction point for the rear and forward skin and is a general support member.

It is machined from an aluminum alloy 220 Temper T4 sand casting per Specification QQ-A-601.

H. BASE AND BALLAST ASSEMBLY (8833461)

The ballast assembly is mated to the base assembly using 15 MS35298-62 screws.

I. BALLAST ASSEMBLY (8833431)

The ballast assembly is constructed of steel and consists of a 29.7-inch diameter plate, 1/2-inch thick, a 4-1/2-inch O.D. steel pipe with three supports placed 120° apart and one 14-inch thick slug of 20-inch diameter. All parts of the ballast are joined by welding. The ballast assembly adds the necessary weight requirement of the warhead and is designed in such a way that the center of gravity requirement of the warhead is met.

In the non-production engineered ballast assembly the ballast consisted of 14 one-inch plates, which were joined by 1/2-inch longitudinal welds, at 12 places. The non-production engineered ballast assembly also used a washer between the lifting ring and the ballast. The lifting ring passed through all 14 plates.

In the production engineered ballast assembly a manufacturer was found which produces steel billets of the diameter required for the ballast. By using a 14-inch long billet instead of 14 one-inch thick plates, cutting and welding operations were eliminated. The solid ballast permits a two-inch deep thread

to receive the lifting ring thus eliminating the drilling of a hole through 14 plates. A washer was also eliminated in the production engineered ballast assembly.

Ballast (8833430)

The ballast provides the bulk weight of the ballast assembly and is made from steel, Class E, Specification MIL-S-11415.

Ring, Lifting (8833444)

The lifting ring is used for lifting and handling the ballast assembly and is made from cold rolled C-1008-C-1025 steel Specification QQ-S-633.

Tube (8833426)

The main purpose of the tube is to separate the ballast from the plate the required distance so the center of gravity requirement of the warhead is met. It is commercial carbon tubing condition CDSR, Specification QQ-T-830.

Support (8833471)

The three supports are welded to the tube and each end of the support is welded to the plate and the ballast, respectively. The support is made from steel plate, Specification QQ-S-741.

Plate (8833449)

The plate serves as a mounting surface for the ballast assembly to the frame base. It is secured by 15 bolts. The plate is made from steel plate, QQ-S-741.

J. BASE ASSEMBLY

The base assembly is a major structural member of the warhead. It is an inverted truncated conical section consisting of a base frame, four base fitting assemblies, two half skins, two well charges and a base ring fastened together with lockbolts, blind rivets, and screws.

The thrust of the rocket motor is transferred to the head structure through the base skins via the base frame and the base fitting assemblies.

Skin, Base (8833459)

Two base skins enclose the base assembly and continue the contour of the aft end of the head. The skins transmit part of the thrust of the rocket motor through the base fitting assemblies to the base frame. The skins are fabricated from aluminum alloy 2024-T3 per QQ-A-355. They are blanked from sheet stock and rolled into half cones. The final operation trims the respective longitudinal and circumferential length of the skin.

Well, Charge (8833460)

In the production-engineered warhead the charge well was converted from a machined fabrication to a simple casting. The two charge wells (Figure 15) house the spotting charges (Figure 16) and are designed in such a manner that at event the spotting charge burst outward with a maximum of flash and smoke.

Frame, Base (8833468)

The base frame is the main structural member which absorbs the total thrust. The thrust is transferred to the rest of the structure via the rear skin and adjacent structure. Lifting holes are provided in the base frame to handle the head when processing and transporting.

The base frame is machined from an aluminum alloy permanent mold casting, Class 4, condition T6 per QQ-A-596.

Lockbolt (8796735, 8831215, 8831231)

The primary fasteners throughout the base assembly are 1/4-inch-diameter steel lock bolts, which transfer the thrust of the rocket through the skins to the head. They are standard catalogue items. The only difference between the production and nonproduction-engineered bolts is in the grip range length. The length is determined by the material thickness. The lockbolts have radial grooves to which the collars are swaged. Eight are used to fasten the fittings and skin to the frame, 68 to fasten the skin to the frame, and 88 to fasten the skin to the fittings.

Collar, Lockbolt (8796736)

The collar is swaged into grooves in the lockbolt. It ties the assemblies together in the manner of a lock washer and nut. The material is aluminum alloy 2024-T4 per QQ-A-268.

Rivet, Blind (8796737)

Fifty-two 3/16-inch-diameter blind rivets are used to fasten the base skins to the base ring. The rivet is a standard aluminum item.

Screw (AN509-10R8)

Two #10 screws are used to fasten each fitting to the base ring. They are coated with zinc chromate before use.

Ring, Base (8831217)

The base ring is one of two stiffening rings used in the head. It is located at the aft end of the head and stiffens the base skins. Four holes in the ring provide clearance for the base fitting inserts. Eight tapped holes in the ring are used to fasten the pressure diaphragm assembly to the base ring.

The ring is a circular channel, fabricated from aluminum alloy sheet 6061-1 per QQ-A-327. The part is blanked in the "O" condition and solution heat-treated to the SW condition. It is formed, pierced and then age hardened to the T6 condition.

K. BASE FITTING ASSEMBLY (8831218)

Four base fitting assemblies aid in transmitting the thrust of the rocket motor to the rest of the structure. An assembly consists of a base fitting into which a one-piece combination bushing and thread insert fitting is threaded. The insert is locked in place by a set screw. The head of the insert is located in the base fitting and protrudes partly into the base ring. The four holes in the base ring, the four inserts, and the four internal wrenching bolts (5306-333-0487) align the warhead to the pedestal assembly of the rocket motor.

The insert is fastened in place using an assembly fixture. It is locked by jamming a set screw against the external thread of the insert. The insert replaces the Helicoil and bushing of the nonproduction-engineered assembly. The Helicoil and bushing combination required two assembly operations.

Fitting, Base (8831219)

Four base fittings aid in transmitting the thrust of the rocket motor through the base skins. A portion of the thrust is transmitted directly to the base frame. The face of the fitting fits in the channel form of the base ring. The face is counterbored and tapped to accept the insert. A step at

the forward end mates with and is fastened directly to the base frame.

The fitting is machined from an aluminum precision forging; material is 2014-T6 Specification QQ-A-367. The part has been redimensioned at the forward end to allow lockbolts to replace screws and stopnuts formerly used. The cross section was thickened to take the next lockbolt grip length range and eliminate the spotface operation. A programmed drill machine eliminated the need for pilot holes.

Set Screw (MS 51017-47)

A Military Standard #10 screw locks each insert to the base fitting. This was added to complete the change from a Helicoil and bushing to a one-piece insert.

Insert, Fitting (8833393)

The fitting insert allows the threads to mate the motor to the warhead. The four inserts carry the total weight of the warhead in shear.

The inserts are machined from heat treated steel, Class C2, per MIL-S-11415. This is heat treated screw-machine stock. Machining is done after heat treatment of the bar stock, to meet both strength and tolerance requirements. The new insert replaces a Helicoil and bushing combination of the nonproduction-engineered model.

The older model was subject to in-process damage from use in attaching and removing from the assembly fixtures. The new insert provides a stronger and more wear-resistant thread.

L. PRESSURE DIAPHRAGM ASSEMBLY (8833394)

The pressure diaphragm (Figure 17) is a closure for the base section. It is used to keep out all foreign material. The pressure diaphragm assembly consists of a formed aluminum sheet, eight screws and a pressure seal. The pressure seal is held in place by four flanges spot welded to the diaphragm. The pressure diaphragm assembly remains on the warhead metal parts assembly during flight.

The nonproduction-engineered units did not have this assembly. Recent field tests indicated a definite need for this type of assembly.

Diaphragm (8833694)

The diaphragm, the major component of the pressure diaphragm assembly, is blanked and formed from 6061 aluminum sheet stock Specification QQ-A-327. The part is formed in the SW condition, then age-hardened to T6. The diaphragm is preformed, age-hardened, and the six compatibility holes are pierced.

Flange (8833695)

Four flanges retain the O-ring of the pressure diaphragm assembly and position the whole assembly to the metal parts assembly. The flanges are shaped 90° circular arcs which are spotwelded to the diaphragm.

The flange is fabricated from 6061 aluminum sheet stock Specification QQ-A-327. It is blanked in the "O" condition, solution heat-treated, formed in the SW condition, then age-hardened to T6 condition.

Seal, Pressure (8833696)

The pressure seal fits around the flanges of the pressure diaphragm assembly. It seals the aft end of the unit from all foreign material. The pressure seal is fabricated from rubber tubing vulcanized to form an O-ring.

Screw (8825116)

Eight #10 screws fasten the pressure diaphragm assembly to the base ring. The screws are coated with zinc chromate before inserted into the base ring.

III. QUALITY CONTROL AND INSPECTION ENGINEERING

The quality control system is to establish methods and techniques which assure the government that the units meet the specifications and quality requirements of the contract. These objectives were accomplished for minimum labor cost and minimum material destroyed for acceptance inspection and testing.

It was decided that dependable quality could not be economically insured by acceptance or rejection of the final product alone. The M38 Warhead Section was analyzed piece-by-piece and sub-assembly-by-sub-assembly, to determine which characteristics were essential to the assembly and to the function of the completed item.

Basic Assumptions

Based upon experience in previous missile work the following assumptions were made which were used in evolving the quality control system:

- a. Functional testing of end product is not practicable because it would result in destruction of the metal parts assembly. It would be expensive and impractical to functionally test completed assemblies. In addition, the functioning of the unit was determined satisfactory by numerous tests in the research and development phases of the assembly.
- b. Production quantities would be relatively small. At this rate it would be economically impossible to justify automatic or "rapid check" type-gaging.
- c. The quality approach must take adequate control of essential piece part and subassembly characteristics, coupled with visual and dimensional examination of final assemblies. Proper controls must be maintained throughout the manufacture and assembly of the metal parts to assure that they meet functional requirements.

Inspection Procedures

Inspection procedures form the fundamental documents, prescribing part and assembly acceptance criteria for the line inspector. The information contained in this study must be accurate and convey precisely the requirements of design, process and quality control engineering.

A program was initiated to provide a systematic evaluation of the design analysis. This program uncovered unnecessary tolerance restrictions and discovered potential trouble areas early. The results led to improved design changes. Process and quality engineering efforts were directed to providing processes and quality programs which were compatible with the revised tolerances placed on the product. With this in mind the Quality Assurance Division wrote the inspection procedures. As a result, the line inspector has the tools necessary to assure that design and manufacturing specifications would be met.

Purchase Specification

Concurrent with the evolution of inspection procedures was the

development of a set of purchase specifications. These specifications were written, utilizing the knowledge gained on the M144 Warhead Section. Only items essential to the function or strength requirements were included.

A. The following specifications are applicable to the M38 Warhead Section:

- a. AEI-70 dated 26 March 1960 with Amendment 1 dated 3 January 63 entitled "Purchase Specification Warhead Section, 762MM, Rocket Practice: M38
- b. AEI-69 dated 31 May 1961 with Amendment 2 dated 3 January 63 entitled "Purchase Description Warhead Section, 762MM Rocket, Practice: M38 Metal Parts for"
- c. MIL-C-45474 dated 11 April 1960 with Amendment 1 dated 2 September 1960 entitled "Military Specification Charge, Spotting For Warhead, XM38E1 for 762MM Rocket Loading, Assembly and Packing".
- d. MIL-C-45476 dated 11 April 1960 with Amendment 1 dated 2 September 1960 entitled "Military Specification Charge, Spotting for Warhead, XM38E1 for 762MM Rocket Metal Parts for."

B. The main effort in developing the specifications was directed toward four main areas. The first was the spelling out of absolutely clear and unambiguous requirements to which the part would have to be made. The second was that dealing with quality control procedures. Efforts in this area were mainly directed towards firmly establishing the areas of responsibility between the contractor and the Procurement District. The third area dealt with Acceptable Quality Levels. The fourth and final major area of effort was the development and establishment of adequate test procedures to assure compliance with the requirements. Economic factors were at all times considered in the development and implementation of the procedures.

Inspection Equipment

The design of gages was made in accordance with the specifications. Economic factors were a prime consideration in determining the type and application of the inspection equipment. Many savings were effected in terms of man-hours required for inspection and reduction in scrap loss, because of the rapidity with which defects could be detected.

The two Inspection Equipment Lists (IELs) for the M38 Warhead Section are IEL 8838005, dated 8 April 1960, and IEL 8833470, dated 17 November 1961.

6

APPENDIX

APPENDIX A

FIGURES

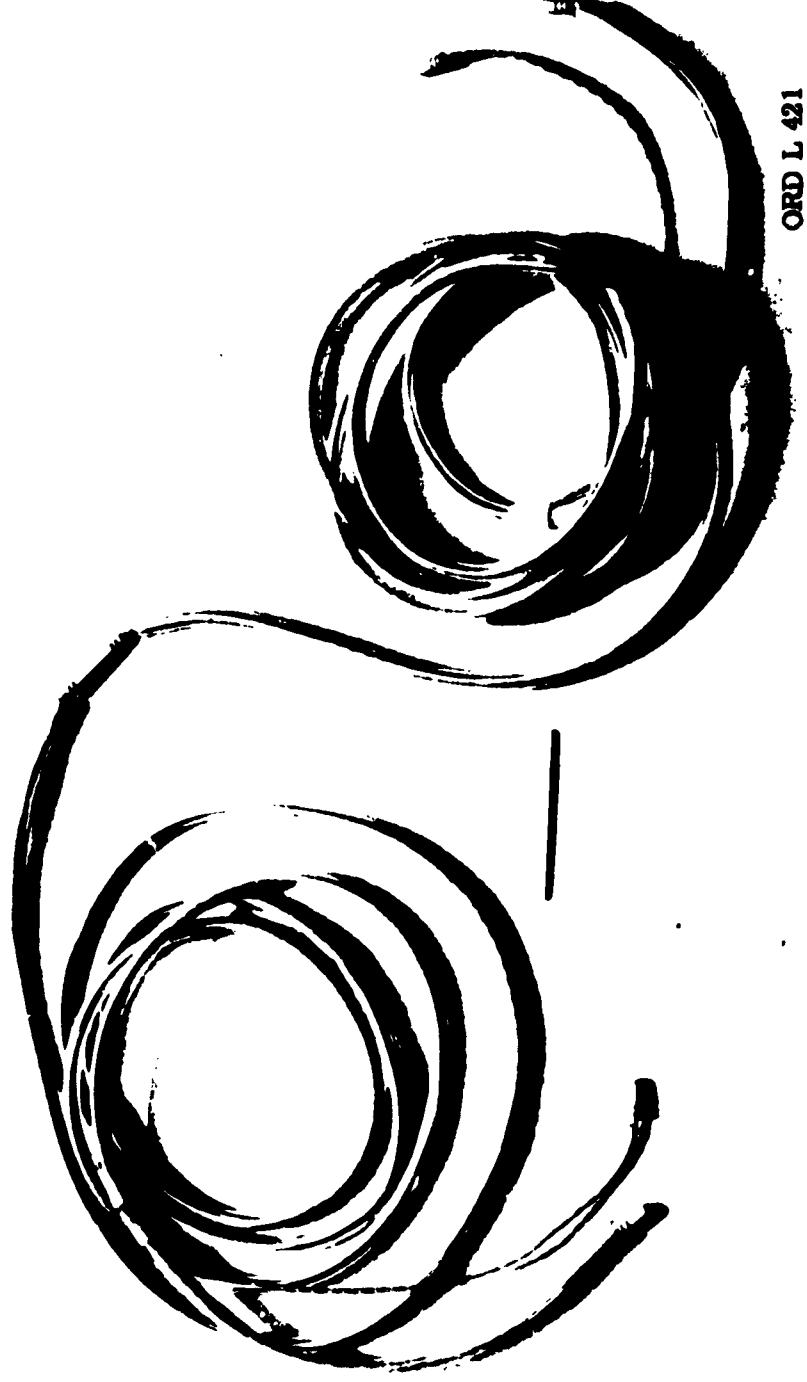


Figure 1. Detonating Lead Assembly

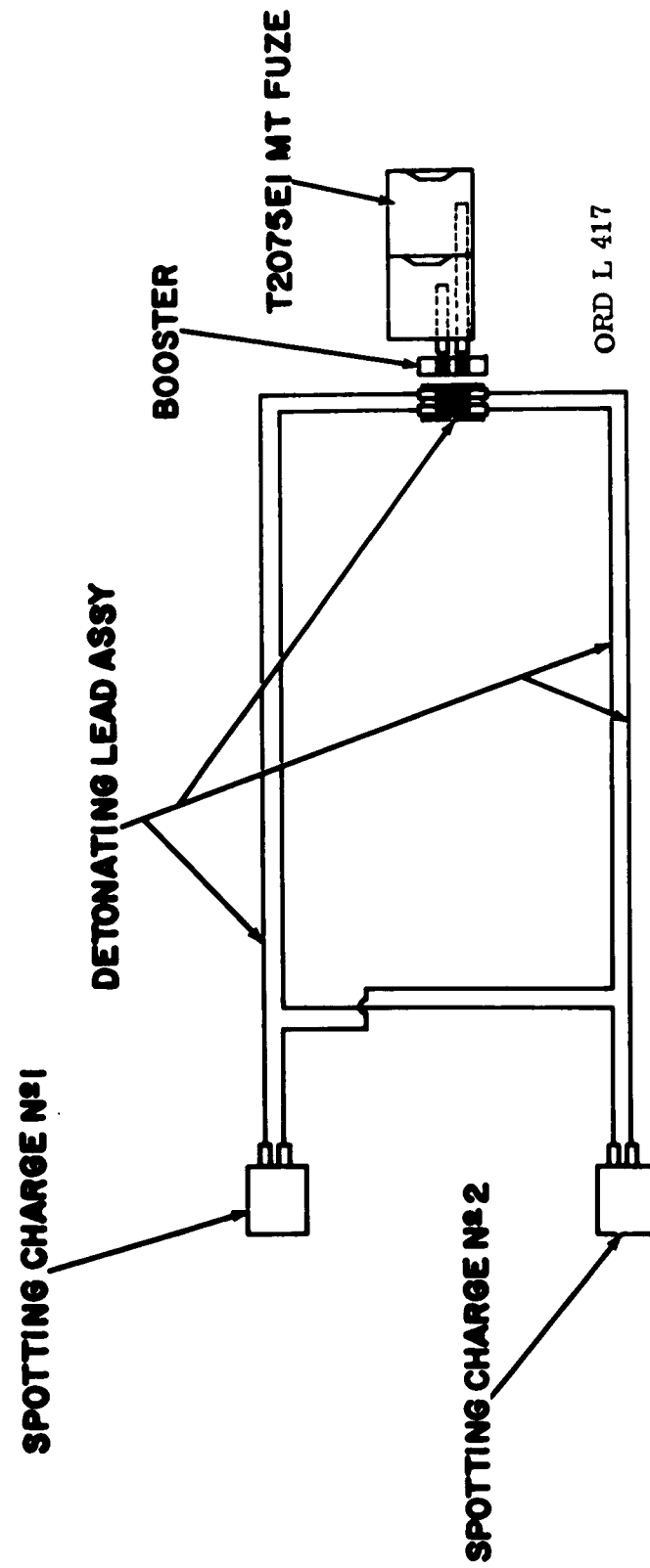


Figure 2. M38 Explosive Schematic

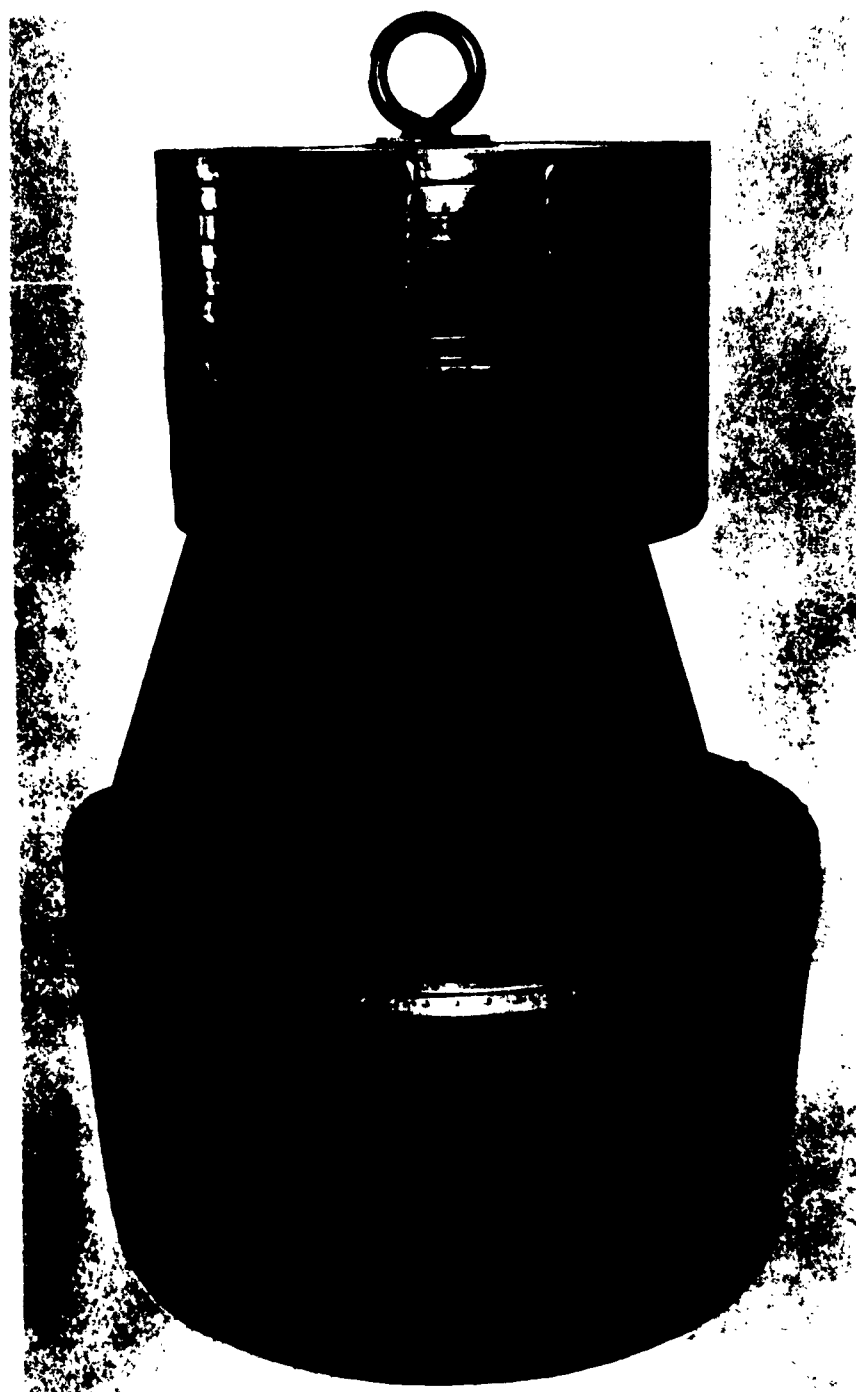


Figure 3. Base and Ballast Assembly

ORD L 413

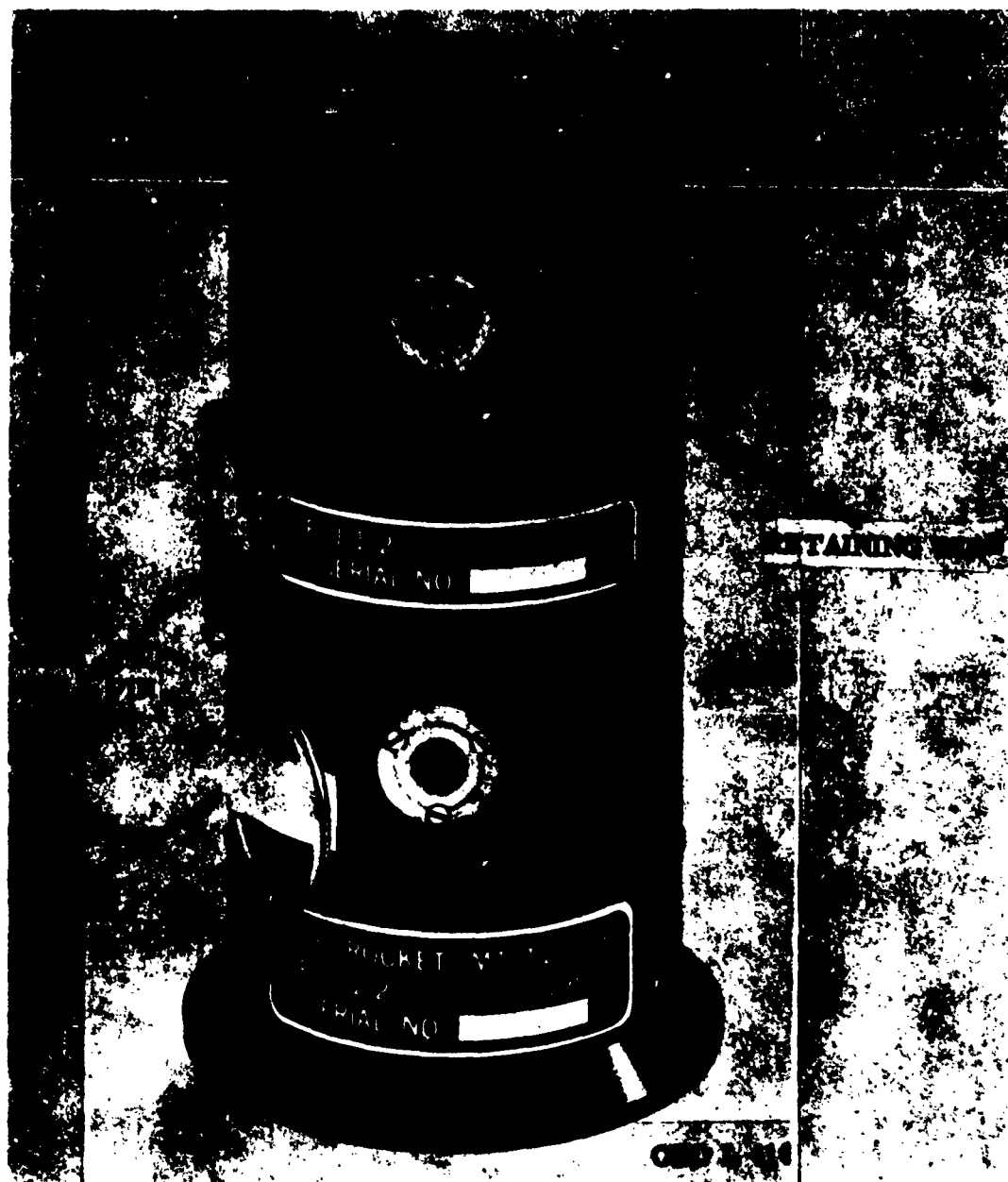


Figure 4. Fuze, Rocket, Mechanical Time, M421 (T2075E1)

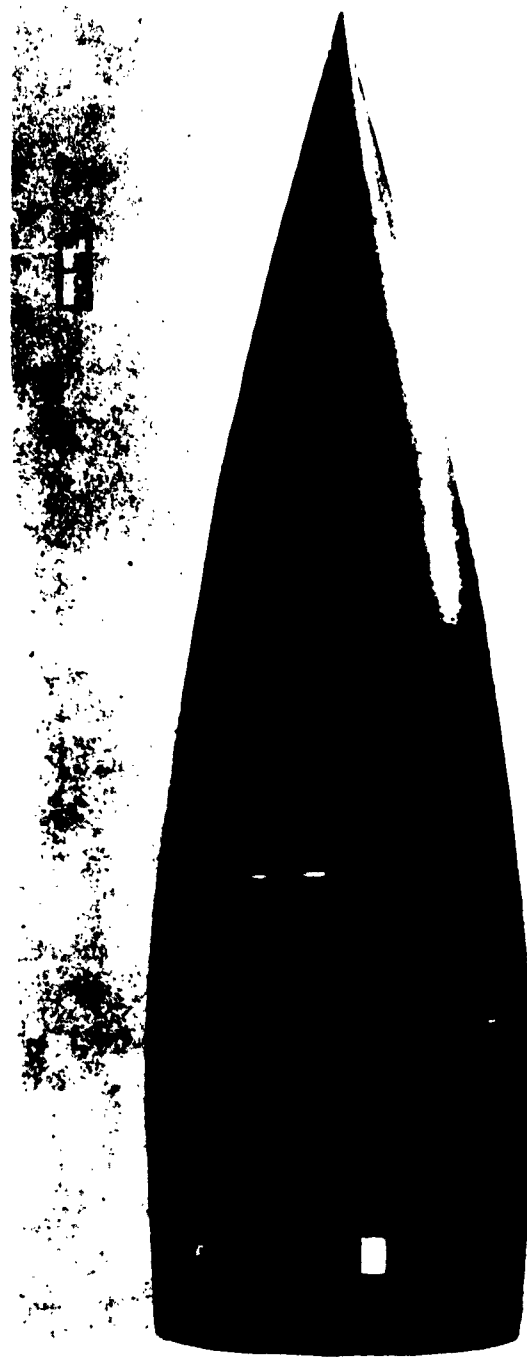


Figure 5. Warhead Section, 762MM Rocket, Practice: M38

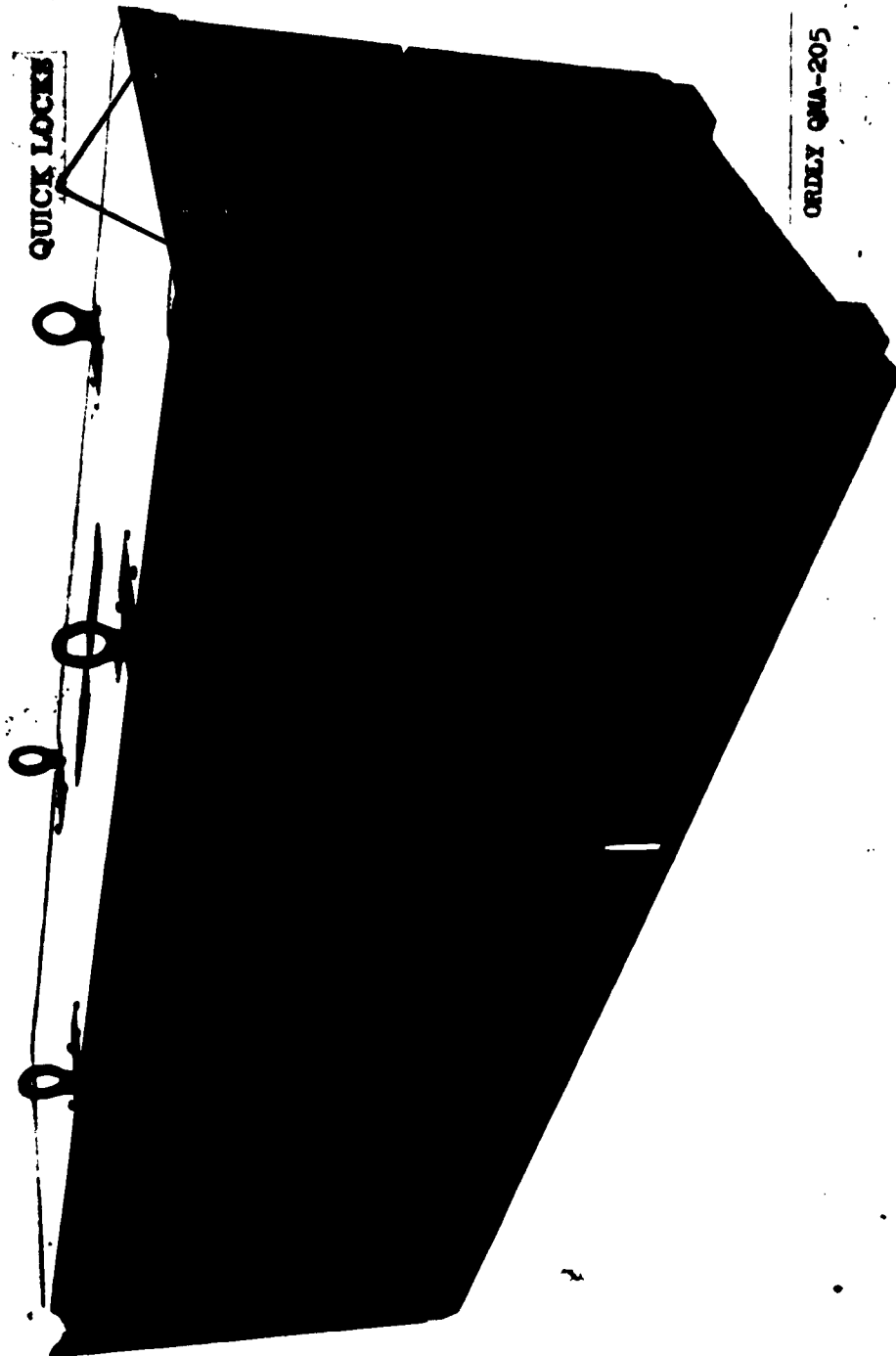


Figure 7. Shipping and Storage Container



Figure 8. Mounting Brackets

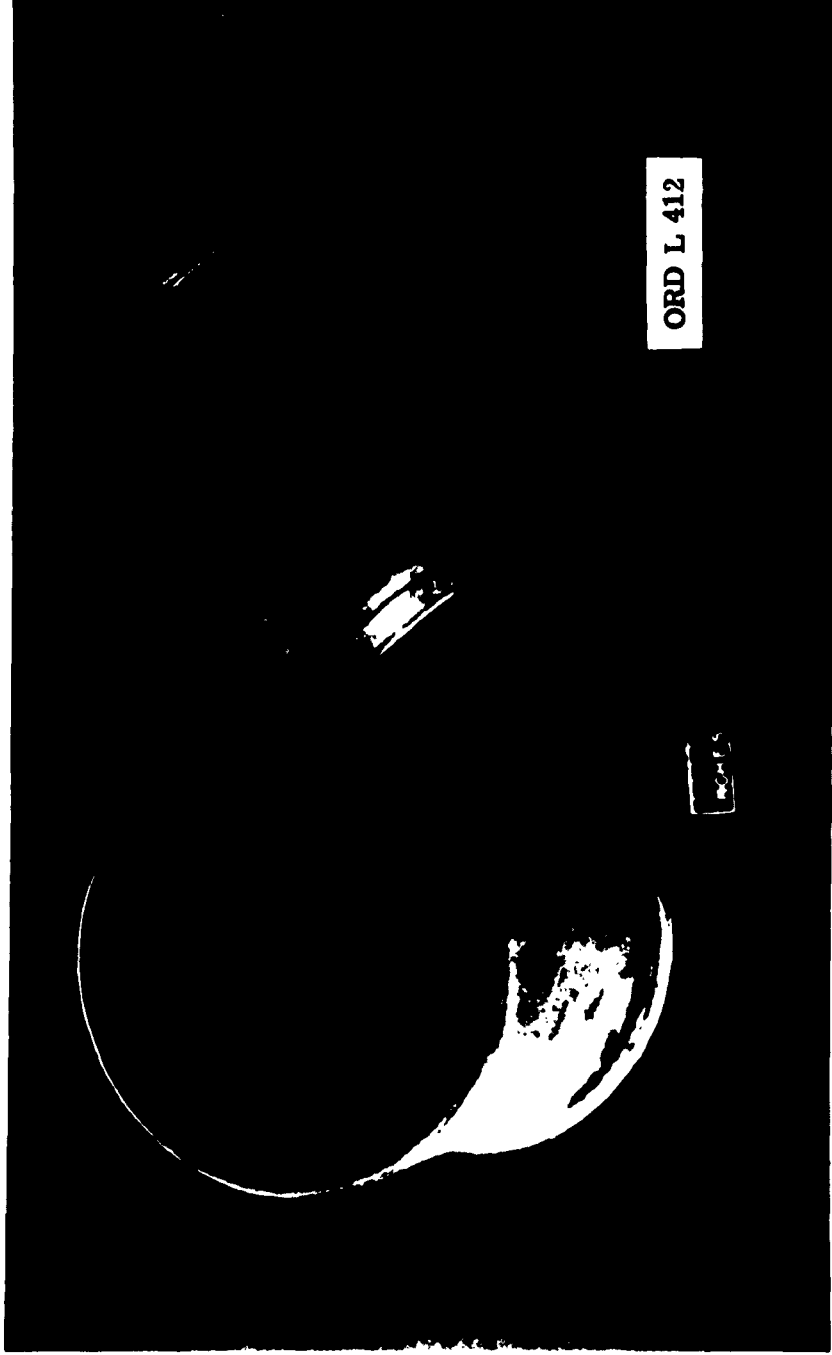


Figure 9. Spotting Charge Canisters

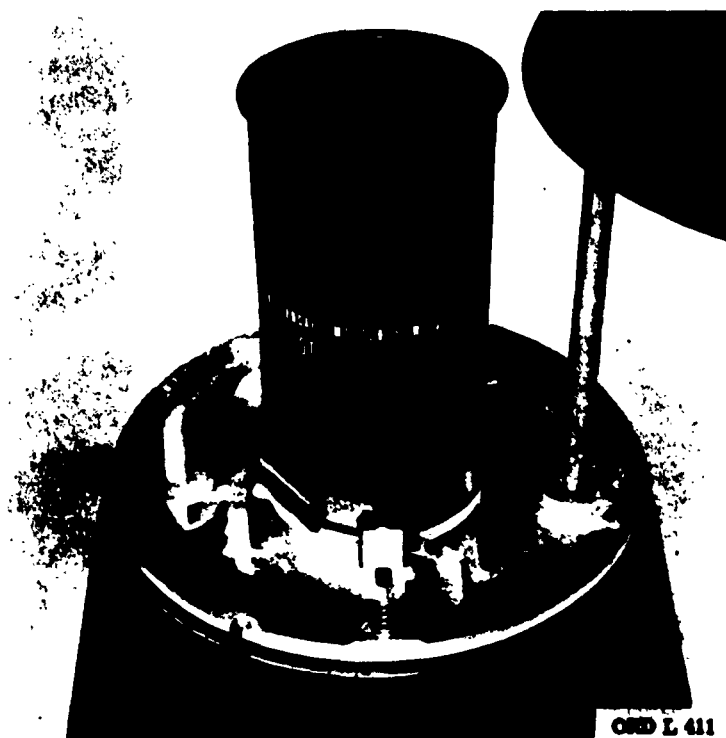


Figure 10. M421 (T2075E1) Fuze Pack



Figure 11. Production Engineered Latch Assembly

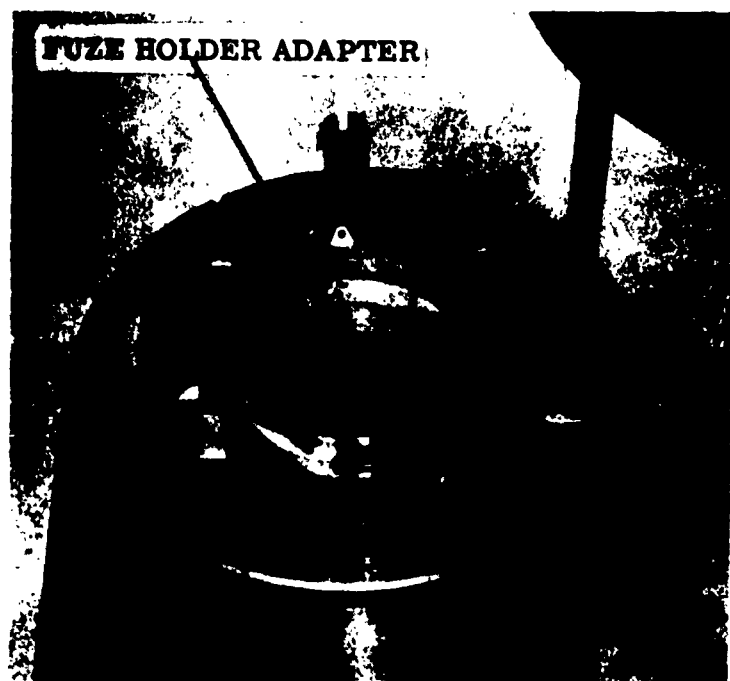


Figure 12. Adapter Assembly Fuze Holder

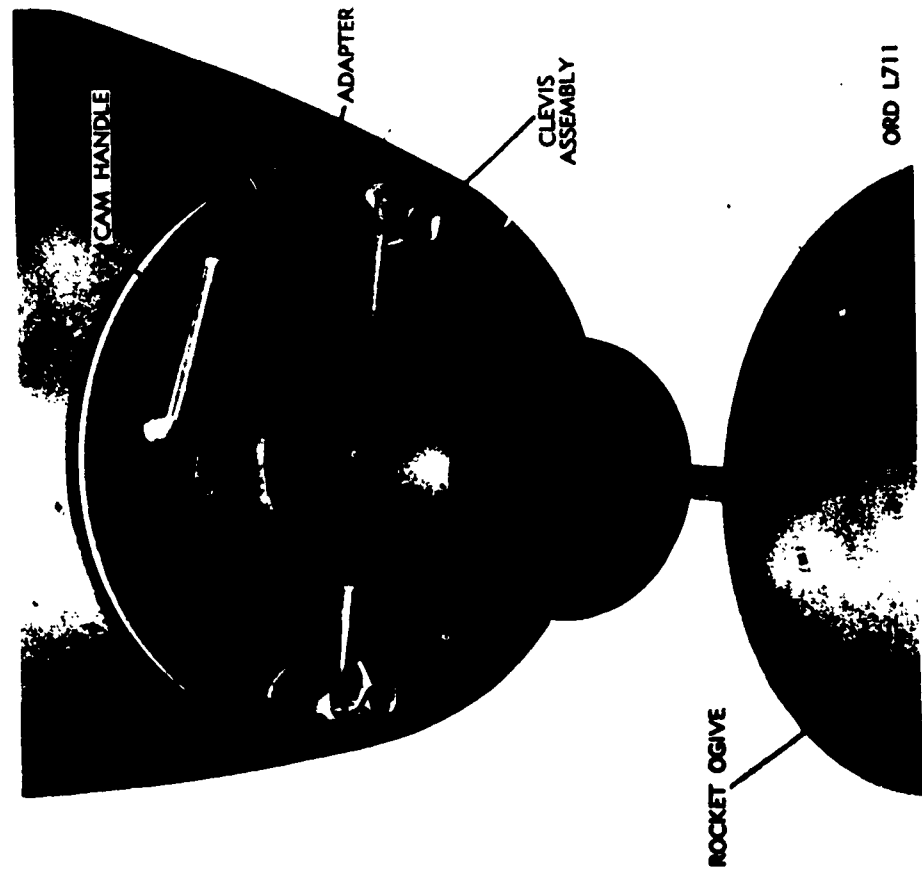
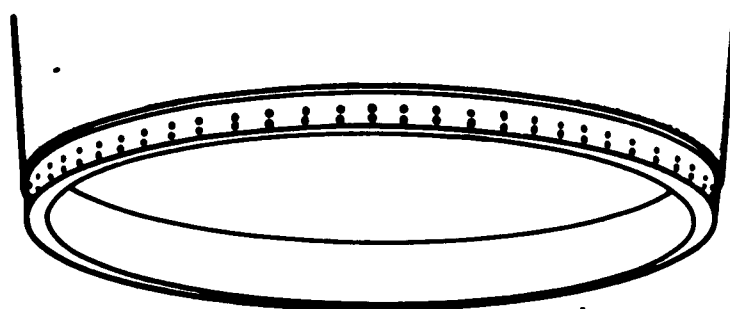
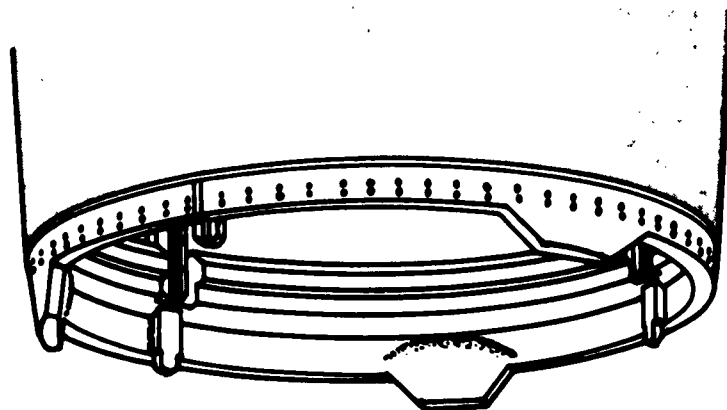


Figure 13. Canned Fuze Clamped to Adapter.



ORD L 396

PE MODEL



ORD L 395

R&D MODEL

Figure 14. Frame Separation

DETONATING LEAD ASSEMBLY

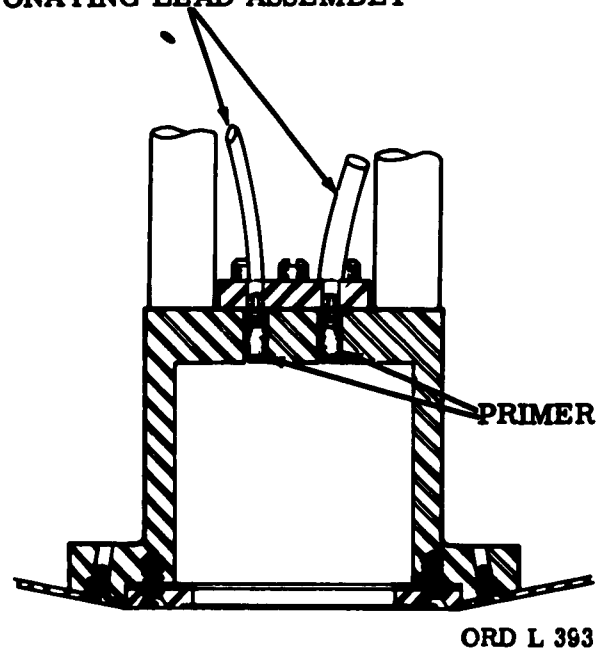
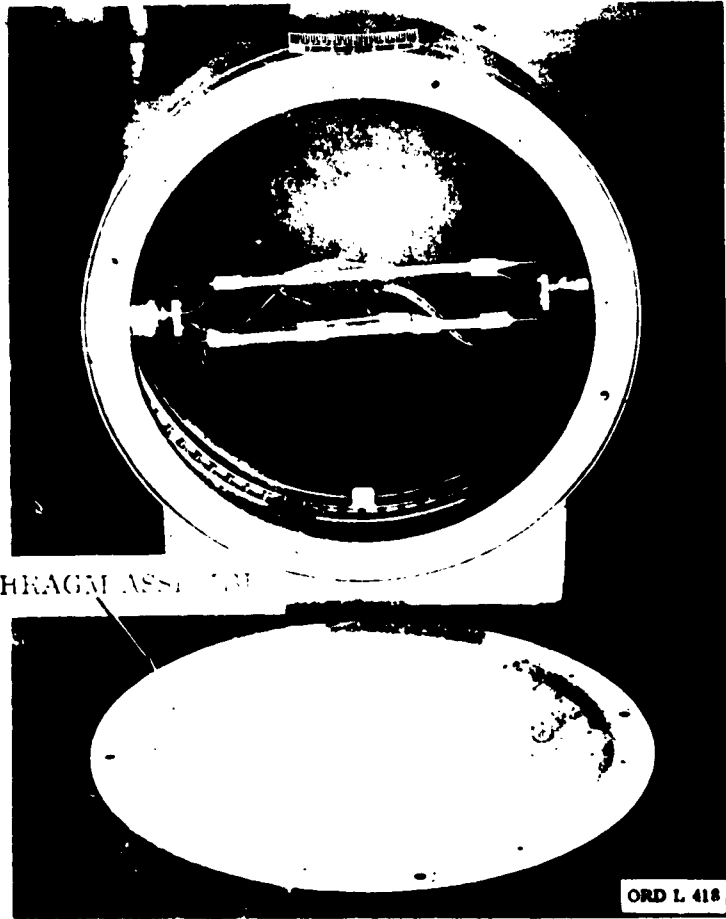


Figure 15. Charge Well

SPOTTING CHARGE

RING

ORD L 419



DIAPHRAGM ASSEMBLY

ORD L 418

ABSTRACT DATA

ABSTRACT

Acession No. _____ AD _____

Picatinny Arsenal, Dover, New Jersey

PRODUCTION ENGINEERING OF WARHEAD
SECTION, 762MM ROCKET, PRACTICE:
XM38 (M38)

Sydney Gordon

Technical Report 3074, July 1963, 53pp,
figures. Unclassified report from the
Applications Engineering Laboratory,
Ammunition Engineering Directorate.

The production engineering project for the
XM38 Warhead resulted in the Warhead
Section, 762mm Rocket, Practice: M38
(XM38E1).

Designed to simulate the M144 (T2044E1)
Warhead Section, the M38 Warhead will be
used primarily with the XM50 Rocket System
(Improved Honest John Rocket).

The M38 Warhead has been standardized and
is in production.

UNCLASSIFIED

I. Training ammunition --
Rockets

I. Gordon, Sydney

II. M38 Practice Rocket

UNITERMS

Warhead

XM38

Honest John

M38

Practice

Rocket

762mm

Gordon, Sydney

Accession No. _____ AD _____
Picatinny Arsenal, Dover, New Jersey
PRODUCTION ENGINEERING OF WARHEAD SECTION, 762 MM ROCKET, PRACTICE: XM38 (M38)
Sydney Gordon
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II. M38 Practice Rocket
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XM38
Honest John
M38
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